Description

Apparatus and method for, in particular mobile, data acquisition

The invention relates to an apparatus for, in particular mobile, data acquisition having at least one input interface for supplying input signals, in particular operating data relating to a vehicle, a machine etc., having a signal processing apparatus, which can be coupled to the input interface, for signal processing of the input signals which are supplied via the input interface.

The invention also relates to a method for, in particular mobile, data acquisition of input signals which are supplied via at least one input interface, in particular of operating data relating to a vehicle, a machine etc., in which the input interface is coupled to a signal processing apparatus for signal processing of the input signals which are supplied via the input interface.

Such an apparatus is used, for example, in vehicles, for example passenger vehicles, commercial vehicles, construction-industry machines, agricultural machines etc. In this case, systematic operating data acquisition and monitoring of the vehicles is frequently desirable.

Such an apparatus is disclosed in GB 2,194,119 A1. The data detection apparatus in this case contains input sensors, which record the status or specific safety or security conditions. Furthermore, a signal processing apparatus is provided, which produces a status report which includes the identity and the location of the data detection apparatus, as well as the respective operating data. The data detection apparatus is

connected to a selector and to a radio telephone, which transmits the status report to a remote station.

The invention is based on the object of specifying an apparatus and a method for, in particular mobile, data acquisition, which allow automated and systematic data acquisition and the passing on of process data, alarm messages etc. in a simple manner.

This object is achieved by an apparatus for, in particular mobile, data acquisition having at least one input interface for supplying input signals, in particular operating data relating to a vehicle, a machine etc., having a signal processing apparatus, which can be coupled to the input interface, for signal processing of the input signals which are supplied via the input interface or interfaces, and for recording data which can be predetermined in the input signals at times which can be predetermined, and having an output interface for supplying output data, which is derived from the input signals in the signal processing apparatus in accordance with rules which can be predetermined, from the signal processing apparatus to a signal conditioning apparatus for conditioning the output data to a transmitting/receiving unit, which can be coupled to the apparatus, for automatic transmission, and/or transmission initiated on request, of the output data to a control center and/or to a predetermined receiver.

This object is achieved by a method for, in particular mobile, data acquisition of input signals which are supplied via at least one input interface, in particular of operating data relating to a vehicle, a machine etc., in which the input interface is coupled to a signal processing apparatus for signal processing of the input signals which are supplied via the input interface, in which data which can be predetermined in the input signals are recorded by the signal processing apparatus at times which can be predetermined, and output data is derived from the input signals in the

signal processing apparatus in accordance with rules which can be predetermined, which output data is passed on automatically to a transmitting/receiving unit which can be coupled to the signal processing apparatus

and/or on request to a control center and/or to a predetermined addressee.

The invention is based on the knowledge that use of a mobile data acquisition apparatus, in particular in the field of complex construction-industry machines, construction-industry vehicles and commercial vehicles etc., allows systematic data acquisition which leads, overall, to better availability of the respective vehicles etc. To achieve this, the data acquisition apparatus is supplied via the input interface with the respective input signals required for evaluation and diagnosis. This input data in the input signals is evaluated in the signal processing apparatus in the data acquisition apparatus, either during operation of the respective vehicle or else when the vehicle is stationary, in accordance with previously defined rules which are stored in the signal processing apparatus, and is passed on either automatically or on request, for example from a control center, via the transmitting/receiving unit to a specific addressee or to the control center. The control center, which is responsible, for example, for a specific fleet of vehicles, in this way has a comprehensive overview of the respective machine states and of the measured values from the vehicles so that, for example, it is possible to identify technical defects at an early stage, relating to the operational reliability or safety and availability of the respective vehicle. Furthermore, this also allows the respective servicing intervals to be optimized on a vehicle-specific basis. The rules required for evaluation of the respective input data are stored in the signal processing apparatus and can in each case be individually matched to the respective vehicle etc. and to the respective specific operating conditions.

One simple and cost-effective option for configuration of the data acquisition apparatus can be achieved by the apparatus having at least one

memory which can be written to, for storage of an operating system for the apparatus and/or of the rules which can be predetermined, in which case the memory data intended for that memory can be loaded remotely via the transmitting/receiving unit.

Effective data processing by the signal processing apparatus can be achieved independently of the respective data format of the input signals by the apparatus having a data converter, which is arranged between the input interface and the signal processing apparatus and is used to remove distortion from the supplied input signals and to provide a standard data format for the input signals which are supplied via the input interface or interfaces.

The input data can be additionally conditioned with regard to the specific addresses by the apparatus having an address allocation unit, which is provided between the data converter and the input interface or interfaces, and is intended for conversion of the source-specific addresses in the input signals to the address format of the data converter.

Data recording and analysis can be made possible, in a similar way to an oscilloscope, by the signal processing apparatus having a data analysis unit, which is intended for recording of selected input signals at times which can be predetermined, with the recording rules being defined in advance by the control center from the short-term monitoring of information which can be derived from the input signals. An energy-saving mode for the apparatus, which is of major importance during mobile use, can be achieved by the apparatus being installed in a mobile vehicle that is powered by a motor or engine, and has a connecting apparatus for connection to the supply voltage in the vehicle, by

the apparatus having means for detection of at least one "Generator of the supply voltage source in operation" first operating mode and of at least one "Generator of the supply voltage source not in operation" second operating

mode, with the work of the data analysis unit being interrupted in the second operating mode. Alarm monitoring and long-term data acquisition can continue to run in this case.

User-friendly monitoring and objective diagnosis based on the input signals which can be processed by the mobile data acquisition apparatus can be carried out, in particular for long-term evaluation purposes, by the signal processing apparatus having a data processing unit for recording information data which can be derived from the input signals in accordance with rules which can be predetermined, and by the apparatus having a first memory for storage of the rules for the data processing unit.

The power management of the data acquisition apparatus is further improved by the first memory having two memory areas, with a first memory area containing the rules for the "Generator of the supply voltage source in operation" operating mode, and a second memory area containing the rules for the "Generator of the supply voltage source not in operation" operating mode.

An alarm function can be produced for the data acquisition apparatus by the signal processing apparatus having an alarm unit for monitoring information data which can be derived from the input signals in accordance with alarm rules which can be predetermined, and by the apparatus having a second memory for storage of the rules for the alarm unit.

The respective alarms produced can be monitored, for example for statistical evaluation purposes, by the apparatus having an alarm archive for entering alarms that have occurred.

The input signals which are gathered in the data acquisition apparatus and can also be checked via an on-line link,

together with the information which can be derived from these signals, is monitored by the signal processing apparatus having a monitoring unit for direct monitoring of input signals and/or of information data which can be derived from the input signals.

An additional action for control and monitoring purposes is provided by the monitoring unit, as the control and monitoring unit, also having control signals, which can be fed in via the input/output interface or interfaces for direct control of operating modes of a vehicle which is coupled to the apparatus.

The options for use of the data acquisition apparatus, as well as the conditioning of the input data, can be further enlarged or extended by the apparatus having the capability to be coupled to a GPS receiver.

One data acquisition implementation, which also involves multiple use of components, can be provided particularly advantageously and in a particularly cost-saving manner by the apparatus being integrated in, and hence coupled to, a car radio receiver and/or a car radio receiver/mobile telephone appliance combination.

The invention will be described and explained in more detail in the following text with reference to the exemplary embodiments which are illustrated in the figures, in which:

Figure 1 shows a block diagram of an exemplary embodiment of an overall system for mobile data acquisition,

Figure 2 shows an illustration of the outline structure of the data acquisition apparatus,

Figure 3 shows an outline illustration of an exemplary embodiment of a data acquisition apparatus,

Figure 4 shows an overview of an example of configuration data for a data acquisition apparatus, and

Figure 5 shows an example of a mask for setting rules in a data analysis unit.

Figure 1 shows a block diagram of an exemplary embodiment of an overall system for mobile data acquisition. The data acquisition system comprises vehicles F1..Fn in a vehicle fleet. The vehicles F1..Fn are each equipped with a data acquisition apparatus MC, with the data acquisition apparatus MC and the interaction with further components in the respective vehicle F1..Fn being illustrated only with respect to the vehicle F1 in each case. The data acquisition apparatus MC has input interfaces S1..S4, via which respective input signals I1..I4 are supplied from data sources Q1..Q4. The first interface S1 is intended, for example, for processing input signals from a communication bus, such as the CAN bus (CAN = **C**ontroller **A**rea **N**etwork) used in vehicles. Operating data for the engine temperature, water temperature, oil pressure, oil temperature, battery voltage etc. are transmitted, for example, via such a data bus. The second interface S2 is, for example, in the form of a serial interface, for example for connection of a keyboard or keypad etc., while the third interface S3, for example in the form of an "on-board I/O" interface, is intended, for example, for the connection of sensors, encoders etc. The fourth interface S4 is used for optional connection of a GPS module (GPS = **G**lobal **P**ositioning **S**ystem). The data acquisition apparatus MC has an output interface SA, which is coupled to a

transmitting/receiving unit 5, for example a GSM module (GSM = **G**lobal **S**ystem for **M**obile Communication). The GSM module 5 is connected to a transmitting/receiving antenna 6. The

vehicle F1 can set up a bidirectional data link via a radio interface 9 between the antenna 6 of the data acquisition apparatus MC and an antenna 11 of a base station 10a..10n. The base stations 10a..10n in a GSM mobile radio network N are connected to a network operator 13 for the mobile radio network N. There is a link 14 from the operator 13 of the mobile radio network N to a control center 15. A further data link is possible, alternatively or in addition, as a mobile data link 16 via a further base station 17 between a receiver E and the operator 13, as a mobile data link 12. A computer 20 having a data processing apparatus 22, a monitor 21 and a keyboard or keypad 23 is used, for example, as the man-machine interface for communication between the control center 15 and the data acquisition apparatus MC.

Figure 1 shows how the data acquisition apparatus MC is embedded within a system for monitoring and diagnosis of vehicles F1..Fn. Instead of the vehicles F1..Fn illustrated in Figure 1, other, both mobile and stationary, vehicles and machines, such as construction-industry vehicles, cranes, containers, tracked vehicles etc., can also be included within such a system. As will be explained in even more detail below with reference to Figure 3, the data acquisition apparatus MC records specific input signals I1..I4 over a relatively long time period. Thus, for example, signals which relate to the operational safety or reliability of the vehicle F1..Fn, such as the water temperature, oil temperature, refrigeration temperature of a refrigerated vehicle etc., can be recorded at specific times in accordance with the rules stored in the data acquisition apparatus MC. The signals recorded in this way can then be transmitted via the output interface, either on request by the control center 15 or on request by any other receiver E, via the output

interface SA and the radio transmitting/receiving unit 5 connected to it, to the control center 15 and/or to the receiver E. This allows effective fault diagnosis, for example in the event of a defect in the vehicle F1..Fn. Furthermore, it is possible

likewise to record specific input signals I1..I4 in the data acquisition apparatus MC over a short time period, for example being started and stopped by trigger events, and hence to obtain highly up-to-date machine/vehicle states on the basis of a very up-to-date display, and to initiate appropriate maintenance and/or repair measures etc. Signals can also be recorded over a short time period, for example, in the form of a direct dialogue link between the control center 15 and the data acquisition apparatus MC, via an on-line link in the form of the air interface 9. The rules in the data acquisition apparatus MC can be constructed such that an alarm signal can also be produced automatically when specific defect events occur, for example when limit values are exceeded. Furthermore, the data acquisition apparatus MC can transmit location data to the control center, based on the location data supplied via the GPS data source Q4. Firstly, this provides theft monitoring and, secondly, it allows a vehicle fleet F1..Fn to be managed with a clear overview of the vehicles to be covered by the control center 15. Furthermore, a voice link is also possible, when required, between the driver of the vehicle F1 and the control center 15 via the radio link 9 between the control center 15 and the vehicle F1, without any separate radio transmitting/receiving apparatus being required for this purpose. Furthermore, for example in the event of a fault, a notebook etc., for example, can also be connected on site via the interface S2, thus allowing the recorded signals to be evaluated on site for fault tracing. The information transmitted from the data acquisition apparatus MC to the control center 15 can be displayed in an optimum manner by installing in the computer device 22 a software packet which is based, for example, on the Siemens WinCC control and monitoring system, or on operating systems such as Windows. This also optimizes

administration, for example of the incoming alarm signals. Furthermore, specific information for the vehicles

F1..Fn, for example traffic radio, data and/or order data etc., can be transmitted from the control center on a vehicle-specific or fleet-specific basis. The rules in the data acquisition apparatus MC for acquisition and transmission of input signal data Ia..4a to the control center are stored in the data acquisition apparatus MC such that the rules can be loaded remotely from the control center 15 in the data acquisition apparatus MC via the air interface 9.

Figure 2 shows an overview of the outline structure of a data acquisition apparatus, in which case this structure will also be explained in more detail with reference to the more detailed outline illustration in Figure 3.

Figure 2 shows an outline illustration relating to the data acquisition and data processing in a data acquisition apparatus MC. The data acquisition apparatus MC has input interfaces S1..S4, as has already been explained in principle with reference to Figure 1. The first interface S1 is, for example, in the form of a CAN interface (CAN = **C**ontroller **A**rea **N**etwork). In the exemplary embodiment illustrated in Figure 3, the second interface S2 is in the form of a serial interface, for example for connection of a keyboard or keypad, while the third interface S3 is in the form of an on-board input/output interface, for example for connection of sensors, encoders etc. The fourth interface S4 is used for connection of the data from a GPS module (GPS = **G**lobal **P**ositioning **S**ystem). The input signals I1..I4 supplied via the interfaces S1..S4 are passed on via an address allocation unit AZ and a data converter EA to a signal processing apparatus 1. The signal processing apparatus 1 has an output interface SA, via which output signals 18 are passed on to a communication driver KT, for example a

GSM driver. The signal processing apparatus 16 contains means A, L, D, M for recording and

monitoring input signals I1..I4, which can be predetermined, at times which can be predetermined. In detail, the means L, A, D, M comprise a data analysis unit D, which is intended for recording selected input signals I1..I4 at times which can be predetermined, with the recording rules for short-term monitoring of information which can be derived from the input signals 1a..4a being defined in advance from the control center. The corresponding rules are stored in a data analysis rule interpreter DR. The rules which are stored in the memory DR can be loaded remotely via the output interface SA, via a link D1. The data signals d determined by means of the data analysis unit D are recorded by means of the recording apparatus DA and a data buffer DP. The data processing unit L is constructed in a similar way. The data processing unit L also contains a memory LR for storage of the rules for recording the input signals 1 to be processed by means of the data processing unit L. A preprocessing unit LV, a data recording unit LA and a data buffer LP are also provided. Further processing units in the signal processing apparatus 16 are the alarm unit A for monitoring information data which can be derived from the input signals 1a..4a in accordance with alarm rules which can be predetermined. The alarm unit A comprises a memory AR for storage of the alarm monitoring rules. The alarms are monitored by evaluation of the alarm signals a supplied to the alarm unit, which are passed on to an alarm monitoring unit AÜ and an alarm archive AA.

The method of operation of the mobile data acquisition apparatus illustrated in Figure 2 will be explained in more detail in the following text with reference to the respective function blocks. The address allocation unit AZ is formed from address allocation tables, which carry out the conversion process between source-

specific addresses and the input map of the data converter EA. The address allocation tables in the address allocation unit AZ are set up

on the basis of the source and on the basis of the supplied input signals I1..I4, and are thus also different. However, the definition of the format (bit, byte, word...), address in the respective input/output map of the data converter EA, bit offset for bit types and, if necessary, the length, are common to them. In order to save addressing space, the data converter EA is separated into data format areas in which the data received via the different sources is entered as an input map. The data converter EA has the tasks of removing distortion between the asynchronous delivery of the data by the sources, and evaluation by means of the downstream signal processing apparatus 1. A further task is for the data converter EA to provide the data using a standard interface, irrespective of the source, and with a standard data format. The central element for long-term data acquisition and data monitoring is formed by the data analysis unit D, which is also referred to as the data analyzer in the following text. The data analysis unit D operates in a similar way to an oscilloscope, that is to say individual selected signals are recorded at defined times. The recording process can in each case be started or stopped by means of the recording rules DR. In contrast to the data processing unit L, the data analysis unit D is used for short-term monitoring of events as they occur. The corresponding rules DR for this short-term monitoring are thus chosen such that the recording of the data signals by means of the recording unit DA takes place only in a "Generator of the supply voltage source in the vehicle in operation" operating mode, or only in an "ignition ON" operating mode. This ensures that the battery voltage of the vehicle in which the data acquisition apparatus MC is arranged is not loaded unnecessarily. It can be seen from the data link D1 that the rules in the data analysis unit D are transferred from a control center to the data acquisition apparatus MC for the running time. By way of example,

Figure 5 shows an example of a mask for setting the recording rules for the data analysis unit D.

The functionality of the data processing unit L corresponds essentially to the functionality of the data analysis unit D. In contrast to the data analysis unit D, the data processing unit L is used for recording data over a relatively long time period in accordance with the predetermined rules LR. Such rules may be, for example: averaging, maximum-value formation, minimum-value formation. The rules LR can be stored by a control center in an appropriate parameter/configuration area. There are also two rule areas in the case of the data processing unit L, namely one rule area for the normal operating mode, and one for what is referred to as the power-safe operating mode. The power-safe operating mode describes the "Generator of the supply voltage source not in operation" operating mode, which generally corresponds to the engine/motor OFF operating mode. The data preprocessing unit LV is used for preprocessing (integration, minimum/maximum-value formation) of the events sampled in the appropriate recording time frame.

The alarm signaling system A essentially has two parts: the alarm archive AA and the alarm monitoring AÜ. The alarm signaling system A monitors signals from the input map of the data converter EA and produces alarm messages. The alarm monitoring AÜ checks the input map, controlled with respect to time and in accordance with the alarm monitoring rules AR, for events that need to be reported. If an alarm situation is identified in this case, then an appropriate alarm message is entered in the alarm archive AA. The alarm monitoring rules AR in this case define when an alarm must be identified as incoming or outgoing. An alarm message may, for example, be passed on via the GSM driver and a radio transmitting unit coupled to it as an SMS message (SMS = Short Message Service) to the control center or to a predetermined receiver (see Figure 1). The alarm

signaling system is also used to monitor the acknowledgement of the alarms that occur.

A further element of the signal processing apparatus 16 is the data monitoring unit M, which allows on-line monitoring of values via a control center.

The output interface SA is in the form of a data request interface, and forms a neutral interface between the functionalities of the data acquisition apparatus MC and the communication driver for the operating station, for example for the corresponding control and monitoring system in a control center. The communication driver AT manages the downstream communication medium, for example a control and monitoring system WinCC, and converts the address messages, which are specific to the respective control and monitoring system, to the output interface SA.

Figure 4 shows an overview of an example of configuration data for a data acquisition apparatus. The configuration database DB contains the configuration data required for the overall system. This database is used to generate the databases DB1, DB2,... required for the individual components. The first database DB1 contains the configuration data required for the data acquisition unit. The databases Q1..Qn in the data sources control the behavior of the behavior of the data sources. The alarm system A defines the rules for alarm monitoring. The databases LR1, LR2 define the recording rules for the data processing unit L (see Figure 3). Furthermore, a [lacuna] can be provided for the database, which is not illustrated in Figure 4, for a classification unit K, defining the classification rules for a classification unit K. The task of the classification unit K is to assess a signal over a relatively long time period. The signal status is allocated to configurable classes. For example, one signal may be subdivided into 10 classes. If, for example, the signal value range is from 0 to 999 and 10 classes of equal size are configured, each

class contains a value range of 100. The first class represents the

range from 0 to 99, the second the range from 100 to 199, etc. The result is then: signal for 140 s in class 1, for 20 s in class 2 etc. The second database DB2, which is managed in the control center, relates to the alarm archive AA and symbol management [lacuna] used for the symbol management required in conjunction with the data analysis unit D, the data processing unit L, the classification unit K and the data monitoring unit M.

The configuration database DB can be produced in a simple manner, for example in the form of Excel tables, or using a graphical configuration tool. At least certain parts of the configuration database DB may contain data that can be loaded retrospectively from the control center and can thus be matched to new monitoring models etc.

Figure 5 shows an example of an input mask for producing rules for a data analysis unit. The input mask M contains a first input field EF1 for presetting the respective input signals to be recorded, and a second input field EF2 for presetting the respective recording rules. The respective signals to be recorded (oil pressure, engine speed, water temperature) are defined in the first input field EF1, together with the time frame for the recording of the signals. The second input field EF2 is used to preset the respective recording rules, for example the engine speed must be recorded when the value is greater than 50.

In summary, the invention thus relates to an apparatus MC and a method for, in particular mobile, data acquisition having at least one input interface S1..S4 for supplying input signals I1..I4, in particular data relating to a vehicle F1..Fn, a machine etc., having a signal processing apparatus 16, which can be coupled to the input interface S1..S4, for signal processing of

the data supplied via the input interface S1..S4, and having an

output interface SA for supplying output data 17 from the signal processing apparatus 16 to a transmission apparatus 5 for transmitting the output data 17 to a control center 15. Automated and systematic data acquisition for process data acquisition, alarm signaling etc. can thus be achieved in a simple manner by the signal processing apparatus 16 having means A, L, D for recording and assessment of input data I1..I4, which can be predetermined, at times which can be predetermined.